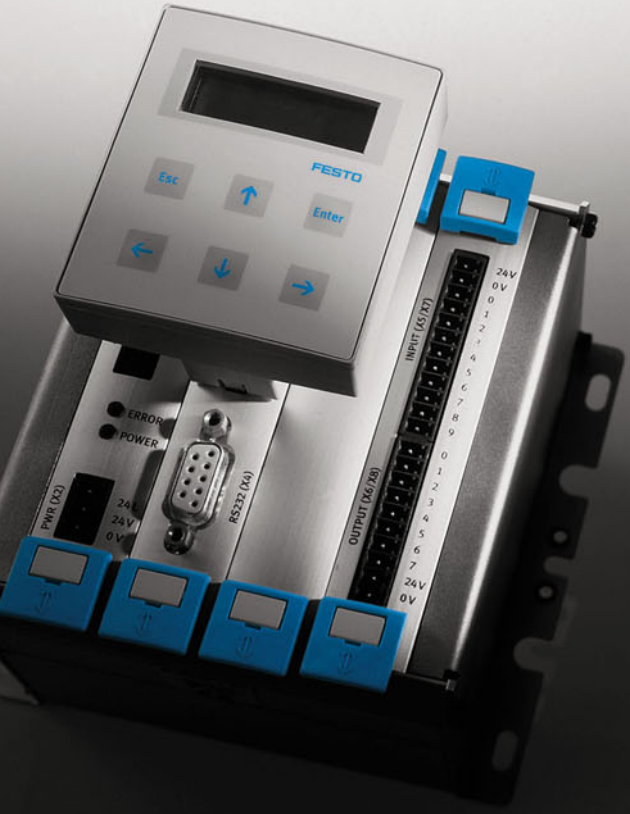
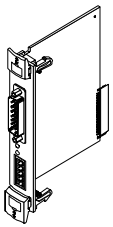
SPC200 Smart Positioning Controller



FESTO

Electronics manual

Stepping motor
indexer module
Type SPC200-SMX-1



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Designated use

The stepping motor indexer module type SPC200-SMX-1 has been designed for coupling a suitable stepping motor controller to the SPC200. With this stepping motor controller the SPC200 can control a stepping motor axis. Maximum 3 stepping motor indexer modules can be fitted in a rack.

Basic components and modules for the SPC200 are described in the user manual type P.BE-SPC200-... . The safety instructions specified in the manuals must always be observed and the relevant components and modules must only be used as intended. Please observe also the safety instructions in the operating instructions for the pneumatic components used. The SPC200 and the modules and cables to be connected are only to be used as follows:

– As specified in industrial applications.

– Without any modifications by the user.
  Only the conversions or modifications described in the documentation supplied with the product are permitted.

– iIn faultless technical condition.

When used together with commercially available components, such as actuators, the specified limits for pressures, temperatures, electrical data, torques etc. must be observed. National and local safety regulations must also be observed.

Target group

This manual is intended exclusively for technicians trained in control and automation technology, who have experience in fitting, installing, commissioning, programming and diagnosing stepping motor axes.

Service

Please consult your local Festo repair service if you have any technical problems.

Important user instructions

Danger categories

This manual contains instructions on the possible dangers which may occur if the product is not used correctly. These instructions are marked (Warning, Caution, etc.), printed on a shaded background and marked additionally with a pictogram. A distinction is made between the following danger warnings:

Warning
This means that failure to observe this instruction may result in serious personal injury or damage to property.

Caution
This means that failure to observe this instruction may result in personal injury or damage to property.

Please note
This means that failure to observe this instruction may result in damage to property.

The following pictogram marks passages in the text which describe activities with electrostatically sensitive components.

Electrostatically sensitive components may be damaged if they are not handled correctly.

Marking special information

The following pictograms mark passages in the text containing special information.

Pictograms

Information:
Recommendations, tips and references to other sources of information.

Accessories:
Information on necessary or sensible accessories for the Festo product.

Environment:
Information on environment-friendly use of Festo products.

Text markings

- The bullet indicates activities which may be carried out in any order.

1. Figures denote activities which must be carried out in the numerical order specified.

– Hyphens indicate general activities.

Notes on software version

Please note
This manual refers to stepping motor indexer modules type SPC200-SMX-1 with software version as from 1.42.

Observe the different positioning speeds depending on the software version of the stepping motor indexer module:

Function	Range	Software version [1)]	Axis moves with
Reference travel	Switching ranges of the limit switches or the reference switch (depending on the reference travel mode) or after a limit switch fault	as from 1.42	Start-Stop frequency
		as from 1.0	1/4 Start-Stop frequency
	Outside the switching ranges of the limit or reference switches	all	Reference speed
Emergency travel	Switching range of the limit switches and movement before reaching the limit switch	as from 1.43 (in preparation)	Start-Stop frequency
		up to 1.42	1/2 Start-Stop frequency
[1)] Determining the software version see section 5.3			

Notes on the use of this manual

This manual contains basic general information on fitting, installing and commissioning the SPC200, as well as a description of its method of operation as a stepping motor controller. The manual deals with the SPC200 Smart Positioning Controller with operating system version as from 4.6 and fitted stepping motor indexer module with firmware version as from 1.42 (see section 5.3, Status display) as well as WinPISA as from version 4.3.

Manuals on the SPC200 Smart Positioning Controller

Type	Title	Contents
System manual	SPC200 Smart Positioning Controller, user manual type P.BE-SPC200-...	Installation, commissioning and diagnosis with SPC200; standard components and modules
Software manual	WinPISA software package type P.SW-WIN-PISA-..	Functions of the WinPISA software package
Help system	Help system for WinPISA (contained in WinPISA)	WinPISA help system
Manuals	Field bus module type P.BE-SPC200-COM-...	Installation, commissioning and diagnosis of the relevant field bus module
	Stepping motor indexer module type P.BE-SPC200-SMX-1-...	Installation, commissioning and diagnosis with a stepping motor
	Electric positioning system type P.BE-ATP-...	Further information on electric positioning systems

Special information on commissioning, programming and diagnosing the SPC200 with the WinPISA software package can be found in the appropriate manual for WinPISA.

Information on the electric axes, drive packages with stepping motors and stepping motor controllers as well as sensors can be found in the documentation supplied with the product.

Caution
If the permitted operating conditions of the components used are not observed, faults may occur during operation.

Consider in particular the specifications for the permitted operating conditions of the motors and drives used in the documentation enclosed (manufacturer data), e.g. for the permitted start-stop frequency or the minimum positioning speeds.

List of abbreviations

The following product-specific terms and abbreviations are used in this manual:

Term/abbreviation	Meaning
Drive package	Stepping motor controller, in some cases with gear
Electric axis	Combination of motor, coupling (coupling housing with coupling and flange), electromechanical linear axis, as well as the necessary cables and sensors.
Electromechanical Linear drive	Linear guide with spindle or toothed-belt drive
I	Digital input
I/Os	Digital inputs and outputs
Modules	Function cards which can be plugged into the rack of the SPC200.
Q	Digital output
Record Select mode	Operating mode of the SPC200 which supports close coupling with a higher-order PLC/IPC.
Resolution	Steps per mm positioning path, depends on the motor used, the drive as well from the configured step mode (see section 4.3.3).
Start-stop frequency	Frequency with which the stepping motor can start and stop reliably at the required rotational speed (without loss of step).
Start/Stop mode	Operating mode of the SPC200 which supports both autonomous operation and control by a higher-order PLC/IPC.
Step mode	The step mode defines the step width (rotary angle of the motor per impulse). Therefore the steps per turn are defined too.

System summary

Chapter 1

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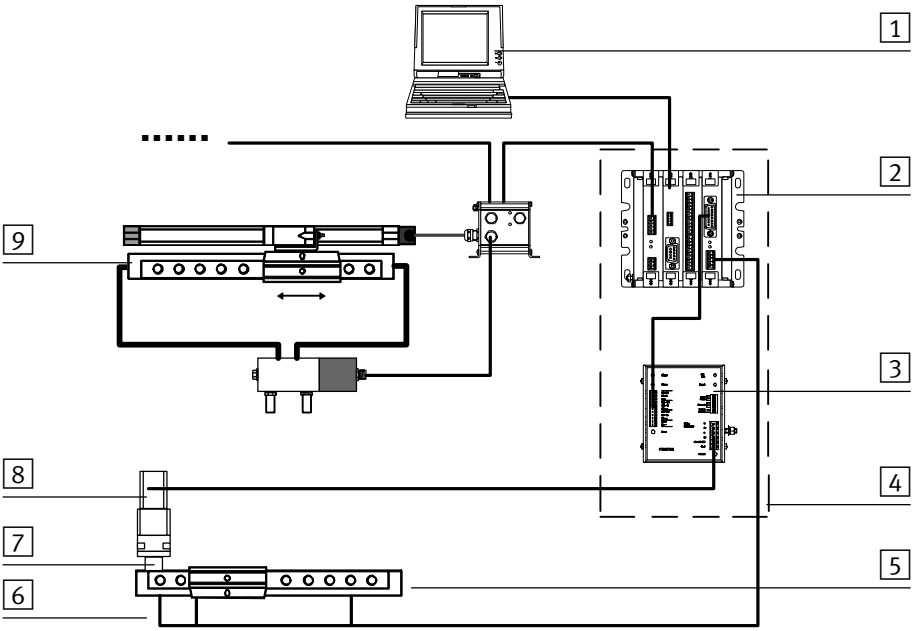
1.1 System structure

Stepping motor drives must be connected to the SPC200 by means of special stepping motor indexer modules. Each stepping motor indexer module type SPC200-SMX-1 enables a stepping motor axis to be coupled on.



1 Programmer/PC for commissioning

2 SPC200 with stepping motor indexer module

3 Stepping motor controller

4 Control cabinet

5 Electromechanical linear drive

6 Reference/limit switches

7 Coupling and flange

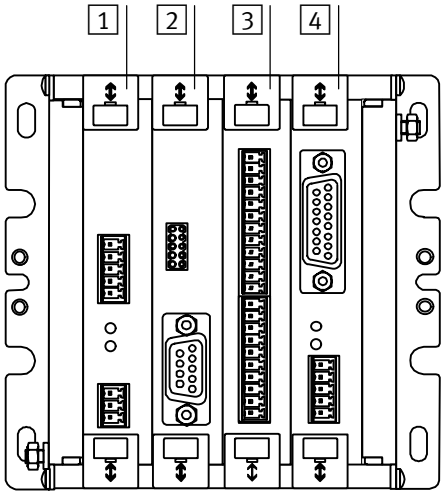
8 Motor, in some cases with gear

9 Pneumatic axis (optional)

Fig. 1/1: System overview

1.2 Basis structure for operating a stepping motor axis

With just the following modules the SPC200 can control a stepping motor controller:



1 Power supply module

2 Diagnostic module

3 I/O module (optional field bus module)

4 Stepping motor indexer module

Fig. 1/2: Basis structure for a stepping motor controller

Module	Description
Power supply module	Enables the power supply and the axis interface designed as a field device to be connected.
Diagnostic module	Enables the control panel to be fitted and a PC to be connected.
I/O or field bus module	Enables control of the I/Os or communication via the field bus.
Stepping motor indexer module	Enables a stepping motor controller to be controlled.

A system structure with the modules shown above offers the following facilities:

– One or two pneumatic axes can be controlled

– Control of one stepping motor axis

– Programming and diagnosis via a PC or a control panel

– Coordination via I/Os or via the field bus

Providing a sufficient number of unused locations are available, up to 3 stepping motor indexer modules can be fitted in the SPC200 for controlling 3 electric axes.

The SPC200 can be controlled via I/Os or via the field bus in the operating mode Start/Stop or in the Record Select mode. The address range required for this is provided by the I/O module or the field bus module.

For setting up a stepping motor axis with the SPC200 you will require the following components:

- The SPC200 Smart Positioning Controller with stepping motor module type SPC200-SMX-1
- The control cable from the SPC200 to the stepping motor controller (see manual for stepping motor controller)
- A stepping motor drive package from Festo, consisting of a stepping motor controller, a stepping motor and, in some cases, also gears. Other stepping motor controllers are possible, providing they have compatible connections.
- Mains filter, fuses etc. for the stepping motor controller
- Motor cable for connecting the stepping motor controller and the stepping motor
- Motor flange and coupling
- Linear drive (e.g. DGE(L)-...), with accessories
- Suitable sensors for reference and limit switches

When selecting the sensors, note that the accuracy of the switchover point of the sensors determines the accuracy of the reference point.

You must make sure that the switchover point always lies within a step resolution.

1.2.1 Connecting and display elements of the stepping motor indexer module

The diagram below shows the connecting and display elements of the stepping motor indexer module type SPC200-SMX-1.

1 Control plug (AMPLIFIER, X30), 15-pin

2 FAULT LED (red)

3 STATUS LED (green)

4 Signal plug (SIGNALS, X31)

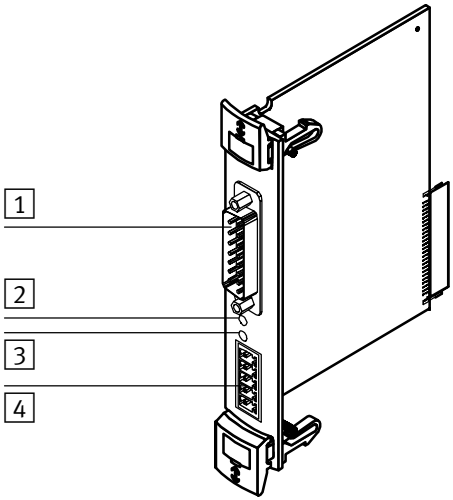


Fig. 1/3: Connecting and display elements

1.3 Drive packages

Festo offers drive packages for electric axes. These consist of:

– stepping motor controller

– stepping motor (in some cases with brake)

– gears (if necessary).

The drive package must be suited to the requirements of the positioning system (moveable mass, positioning time, etc.) as well as to the electromechanical linear axis used.

A stepping motor controller with a 5 V signal level must be used for operating the SPC200 (see “Technical specifications”).

1.3.1 Stepping motor controller

The stepping motor controller forms the link between the SPC200 as positioning controller and a stepping motor.

The signals from the positioning controller are converted by the stepping motor controller in accordance with the motor-dependent and drive-dependent settings (e.g. phase current).

1 Power unit

2 Stepping motor controller

3 Stepping motor

4 SPC200 (positioning controller)

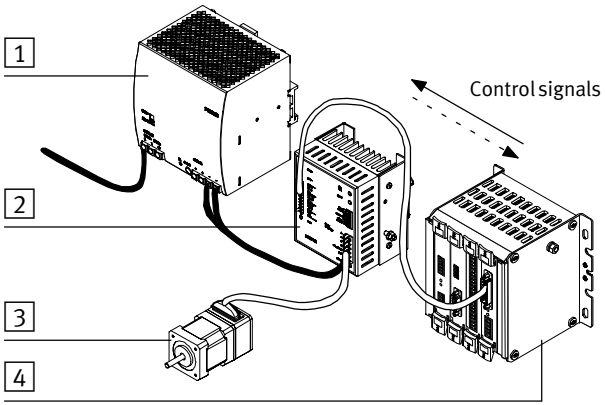


Fig. 1/4: Control connection of the stepping motor controller

The control connection of the stepping motor indexer module type SPC200-SMX-1 has been optimized for the stepping motor controllers offered with the Festo drive packages.

Other stepping motor controllers can only be used providing the necessary inputs and outputs are compatible with the control output of the stepping motor indexer module (AMPLIFIER connection, see “Technical specifications”).

The control connection of the stepping motor indexer module possesses the following inputs and outputs for connecting a stepping motor controller:

Outputs (push-pull control, electric as per RS 485):

– Pulse

– Direction

– Enable

– Full/half step (not used with SEC-ST)

Input (relay contact in the stepping motor controller):

– Ready (bridged in the connecting cable for the SEC-ST)

1.4 Electromechanical linear drive

Linear drives are used for the electric axes. These drives convert the rotary movement of the stepping motor into a linear movement of the slide. If the linear drives do not have an integrated guide, an additional guide must be provided.

Two different types of guides are available:

– axes with spindle drive, e.g. DGE(L)-...-SP

– axes with toothed-belt drive, e.g. DGE(L)-...-ZR

Please note
The maximum length of the linear drives is determined by technical reasons. As from a certain length, spindle drives may only be operated at limited speed and toothed-belt drives may only be operated with limited drive torque.

1.5 Accessories

For the positioning systems Festo offers accessories suited to the drive packages and linear drives (see Festo delivery program or catalogue).

1.6 EMERGENCY STOP concept

Please note
Check within the framework of your EMERGENCY STOP concept, to ascertain the measures necessary for putting your machine/system into a safe state in the event of an EMERGENCY STOP (e.g. switching off the load supply, operating voltage for the stepping motor controller, switching off the compressed air).

The status of the limit switches connected to the sensor plug is evaluated by the operating system of the SPC200.

Warning
The limit switches connected to the sensor plug are not suitable for implementing an EMERGENCY STOP function.

Use additional separate safety limit switches if an appropriate EMERGENCY STOP circuit is required for your application.

Fitting

Chapter 2

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2.2 Fitting the electric axis and the stepping motor controller 2-7
2.2.1 Arrangement of the sensors 2-8

Warning
Before carrying out installation and/or maintenance work, switch off the following in the sequence specified:

1. the compressed air supply
2. all load and operating voltage supplies on the SPC200 and the connected components of the positioning system.

You can thereby avoid:

– unexpected movements of the connected actuators

– uncontrolled movements of loose tubing

– undefined switching states.

2.1 Fitting and removing the stepping motor indexer module

Caution
Modules may be damaged if they are not handled correctly.

- Do not therefore touch the contacts of the components.
- Observe the regulations for handling electrostatically sensitive components.

Discharge yourself electrostatically before fitting or removing components in order to protect the components against discharges of static electricity.

Note the following when fitting the module:

– The stepping motor indexer module can be fitted as desired into any of the slots 2 to 6. Individual identification of all fitted modules takes place automatically.

– The axis identifiers are assigned to the modules or the connected axes in ascending order from left to right without gaps.

– Maximum 3 stepping motor indexer modules can be fitted.

– If a stepping motor indexer module is fitted next to the diagnostic module, a control panel cannot be connected because of the plug for the cable to the stepping motor controller.

The modules are fastened on the rack with the aid of a locking lever. A tool is not therefore required for fitting or removing a module.

Warning
Actuators may make sudden unexpected movements and the SPC200 will be damaged if modules are added or removed whilst the power supply is switched on. Before carrying out installation and/or maintenance work, switch off the following power supplies in the sequence specified:

1. the compressed air supply
2. all load and operating voltage supplies on the SPC200 and the connected components of the positioning system.

Fitting modules

Proceed as follows when fitting a module into the rack:

1. Switch off the compressed air supply and the operating voltage supply.
2. If necessary, remove blanking plate.
3. Hold the module by the front plate and push it into the guide rail. Make sure that the modules are not tilted when they are pushed in and that no components on the printed circuit board are damaged.
4. Make sure that the plugs of the terminal strips are correctly aligned. Then gently push the module in as far as possible. The retaining levers will then lock automatically (see diagram).

1 Direction for unlocking

2 Locks automatically

3 Retaining lever

4 Front plate of the module

5 Terminal strip

6 Guide rail

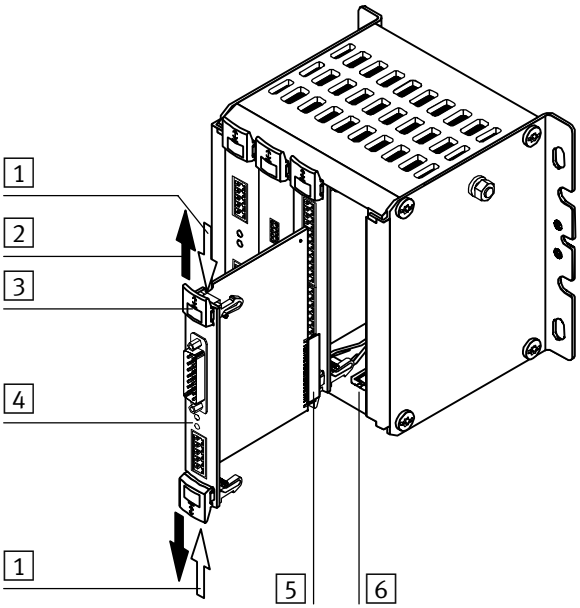


Fig. 2/1: Installing the modules

Removing modules

Proceed as follows when removing a module:

1. Switch off the operating voltage and the compressed air supply.
2. Loosen and pull off the connecting cable on the front of the module.
3. Unlock both locking levers (see diagram) and carefully pull out the module.
4. If necessary, seal the unused slots with blanking plates.

2.2 Fitting the electric axis and the stepping motor controller

Notes on fitting the electric axis and the stepping motor controller can be found in the following documentation:

- the documentation supplied with the stepping motor controller,
- the pneumatics manual for the positioning system type P.BE-ATP-...,
- the operating instructions for the electric linear axis used,
- the instructions for the components used.

Please note
By the arrangement of the limit switches and by additional appropriate mechanical stops, make sure that the axis always lies within the positioning range limited by the hardware limit switches.

Use the correct type of switch for the necessary reference and limit switches:

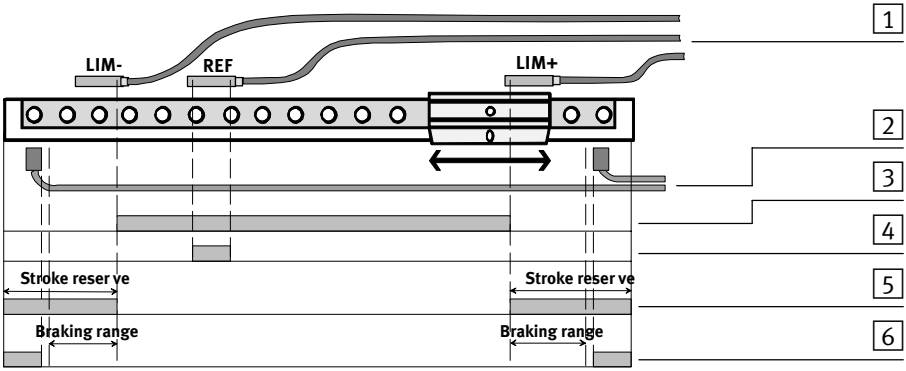
Sensor	Contact
Reference switch	N.O. = normally open
Limit switches	N.C. = normally closed

2.2.1 Arrangement of the sensors

Please note
Please note that:

- the axis must be in the positioning range in order to carry out reference travel.
- the complete ranges outside the permitted positioning range are covered by limit switches (the slide must never stand between the switching range of the hardware limit switch and the mechanical limit stop).
- the switching range of the hardware limit switch, e.g. in the event of programming faults, must permit destructive-free braking (stroke reserve).

The usual arrangement of the sensors on an electric axis with safety limit switches is shown in the following diagram.



1 Sensor connections for control

2 Sensor connections for the EMERGENCY STOP circuit

3 Positioning range

4 Switching range of the reference switch

5 Switching ranges of the hardware limit switch (braking range ‹ stroke reserve)

6 Switching ranges of the safety limit switch (EMERGENCY STOP range)

Fig. 2/2: Arrangement of the sensors

Installation

Chapter 3

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3.3	Connecting the stepping motor controller and the stepping motor	3-8
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3.1 General instructions

Warning
Before carrying out installation and/or maintenance work, switch off the following in the sequence specified:

1. the compressed air supply
2. all load and operating voltage supplies on the SPC200 and the connected components of the positioning system.

Load and operating voltage supplies:

- The load voltage supply for field devices and proportional directional control valves (plug X2, pin 1)
- The load voltage supply for the outputs (plug X6/X8, pin 8)
- If applicable, the load voltage supply on the axis interface string
- The operating voltage supply for the internal electronics of the SPC200 and field devices (plug X2, pin 2)
- The sensor supply on the stepping motor indexer module (connection SIGNALS, pin 4)
- The operating voltage supply on the stepping motor controller

You can thereby avoid:

- undesired movements of the connected actuators
- uncontrolled movements of loose tubing
- undefined switching states
- damage to the electronic components.

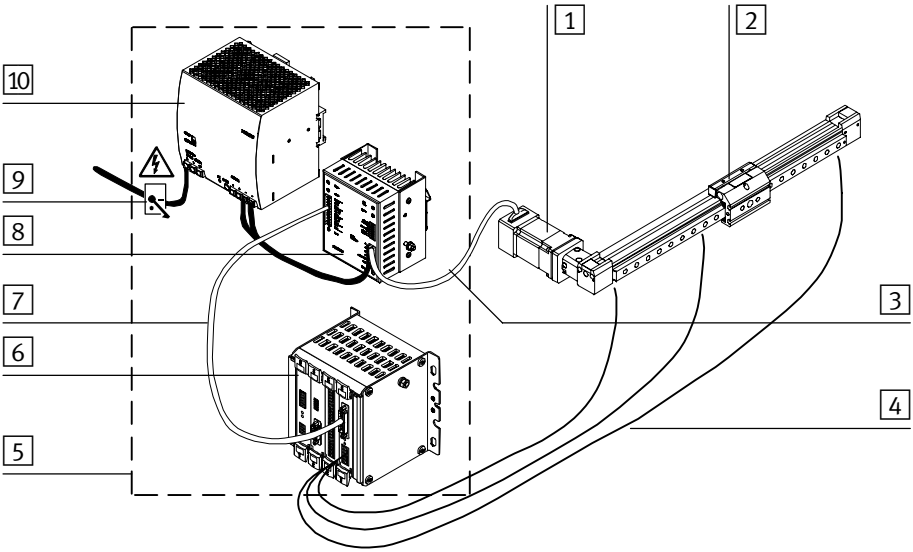
Please note
Connection to the main power supply and the fitting of mains switches, transformers, fuses and mains filters may only be carried out by a qualified electronics engineer.

Caution
Place motor cables and control cables at a distance from each other where possible, e.g. in cable channels with intermediate walls. Use only screened cables for connection to the motor. Twist the control cables in pairs.

In this way you can avoid electromagnetic interference which might impair reliable operation of the system.

Please note
Lay all moveable motor and sensor cables free of bends and free of mechanical stress, if necessary, in a drag chain.

3.1.1 Overview of electrical installation



1 Motor

2 Electromechanical linear drive

3 Motor cable

4 Sensor cable (reference and limit switches)

5 Control cabinet

6 SPC200 with stepping motor indexer module

7 Control cable (e.g. KSPC-SECST-...)

8 Stepping motor controller (e.g. SEC-ST)

9 Main switch

10 Power unit

Fig. 3/1: Overview of electrical installation

3.2 Connecting the sensors

Warning
- Use only PELV **circuits** as per IEC/DIN EN 60204-1 (Protective Extra-Low Voltage, PELV) for the electrical supply. Consider also the general requirements for PELV circuits in accordance with IEC/DIN EN 60204-1.
- Use power **supplies** which guarantee reliable electrical isolation of the operating voltage as per IEC/DIN EN 60204-1.

By the use of PELV circuits, protection against electric shock (protection against direct and indirect contact) is guaranteed in accordance with IEC/EN 60204-1 (Electrical equipment for machines, General requirements).

Please note
Check within the framework of your EMERGENCY STOP circuit to ascertain the measures necessary for putting your machine/system into a safe state in the event of an EMERGENCY STOP (e.g. switching off the operating voltage, switching off the compressed air).

1 LIM+: Positive limit switch

2 REF: Reference switch

3 LIM-: Negative limit switch

4 24 V: Supply

5 0 V: Supply

6 Earth/ground connection

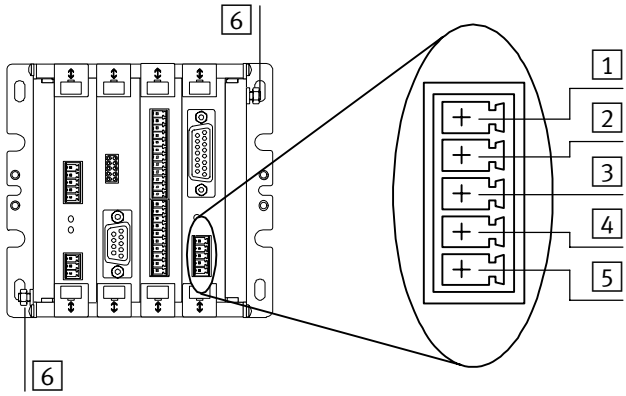


Fig. 3/2: Pin assignment of sensor plug (SIGNALS, X31)

Use the correct type of switch for the necessary limit and reference switches (see section “Fitting”).

When selecting the sensors, note that the accuracy of the switchover point of the sensors determines the accuracy of the reference point.

You must make sure that the switchover point always lies within a step resolution.

The following diagram shows as an example the connection of the sensors.

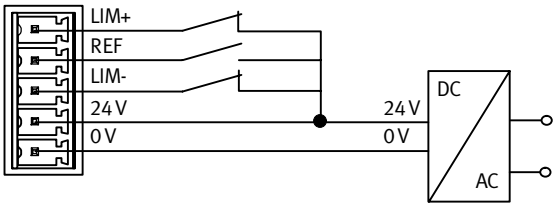


Fig. 3/3: Connection diagram for the sensors

3.3 Connecting the stepping motor controller and the stepping motor

Fit the stepping motor controller and the motor cable in accordance with the accompanying description.

Please note
In order to comply with EMC, a mains filter may have to be installed between the mains supply cable and the stepping motor controller.

3.4 Connecting the control cable

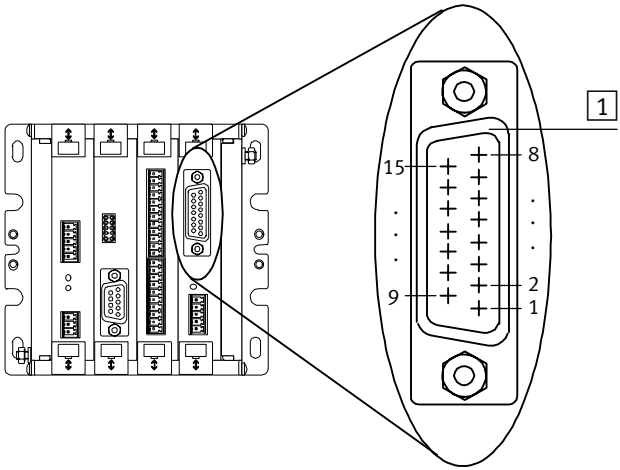
There is a sub-D plug on the stepping motor indexer module for connecting the SPC200 to the stepping motor controller (AMPLIFIER, X30).

This plug has been designed for stepping motor controllers with 5 V control signals.

Use the special cables from the Festo range for connecting the stepping motor controller.

If you use a stepping motor controller from a different manufacturer, you must prepare a cable in accordance with the manufacturer's instructions.

In this case, connect the cable screening on both sides with the plug housing.



1 AMPLIFIER connection

Fig. 3/4: Control plug (AMPLIFIER, X30)

Pin assignment of control plug (AMPLIFIER, X30)

Pin	Signal	SEC-ST	Pin	Signal	SEC-ST
1	+ PULSE	Clk + 5	9	- PULSE	Clk -
2	+ DIRECTION	Dir + 5	10	- DIRECTION	Dir -
3	+ ENABLE	En + 5	11	- ENABLE	En -
4	Not connected	–	12	Not connected	–
5	+ F/H STEP (full/half step)	– 1)	13	Not connected	–
6	- F/H STEP (full/half step)	– 1)	14	Not connected	–
7	Not connected	–	15	- READY	– 1) 2)
8	+ READY	– 1) 2)			

1) Not used with stepper motor controller SEC-ST
2) Connections bridged in the connecting cable

Meaning of the signals on the control plug:

Signal	Meaning
+/- READY	Input: Readiness of the stepping motor controller via relay contact.
+/- PULSE	Output: Step control for the motor; each rising signal edge corresponds to a step.
+/- DIRECTION	Output: Determines the direction of rotation of the motor.
+/- ENABLE	Output: Enable signal for the stepping motor controller.
+/- F/H STEP	Output: Defines whether the motor is controlled for full or half step.

Commissioning

Chapter 4

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4.1 Procedure for commissioning

For user-friendly commissioning and programming of an SPC200 with stepping motor indexermodule, you will require the WinPISA software package as from version 4.3.

However, commissioning can also be carrried out by means of the control panel.

The following list provides an overview of the steps required for commissioning:

1. Check the stepping motor controller. Set the necessary parameters on the stepping motor controller. Check the function and arrangement of the limit switches.
   Provide the necessary system inputs on the SPC200 (see “Preparing commissioning“).

General commissioning of the SPC200:

2. First check and save the hardware configuration of the SPC200 (see WinPISA or SPC200 manual).

Commissioning the stepping motor axes:

3. Set the axis and application parameters for the stepping motor axes to be used.
4. Check the function of the stepping motor axes:
   - Inputs (reference and limit switches)
   - Rotational direction of the stepping motor
   - Positioning the axis
   - Reference travel
5. Check that each axis has been correctly commissioned by means of a simple test program.

4.2 Preparations for commissioning

Check the connection to the mains power supply

- Make sure that the stepping motor controller and the SPC200 are disconnected from the power supply.

Check the voltage for the stepping motor controller and the 24 V power supply.

Check that the stepping motor controller is correctly installed

- Check the installation of the stepping motor controller in accordance with the accompanying documentation.

Set the parameters of the stepping motor controller

Caution
The stepping motor and the stepping motor controller may be damaged when under tension if the pre-settings are incorrect.

Leave the main switch switched off until all the parameters have been set correctly.

- Check the settings on the stepping motor controller (see manual for the stepping motor controller), e.g.:
  - the phase current
  - the step size
  - the step mode (or Micro/Half step)
  - the direction of rotation
  - the current reduction.

The settings of the maximum phase current depend on the stepping motor connected. The maximum permitted phase current is specified on the type plate of the stepping motor.

Caution
Excessive currents can damage the motor.

Do not set a current higher than that specified for the motor, as otherwise the motor will be overloaded.

Select the next lower value if the specified current cannot be set.

Please refer to the documentation on the stepping motor controller for the correct pre-settings and for instructions on optimizing the settings.

Switching on the power supply on the SPC200

Please note
Make sure that the axis is always within the positioning range defined by the limit switches when it is switched on and before the start of reference travel.

When you have checked the installation and parametrizing of the stepping motor controller, switch on the power supply for the SPC200.

Electric linear axis

Proceed as described in the operating instructions for the electric linear axis.

Check especially the position and functioning of the limit switches.

Carry out the first tests as follows:

– with the compressed air switched off (providing pneumatic axes are connected to the SPC200)

– without work load

– with disconnected coupling.

If the motor continues to run when the power supply for the stepping motor controller is switched on, switch off the power supply immediately and check the signal connections as well as the earth and power cables.

System inputs for commissioning

With some commissioning steps, e.g. the signals ENABLE, START and STOP are required for controlling the axes. For commissioning stepping motor axes e.g. with the steps:

– Move to reference point

– In some cases emergency movement (diagnosis and fault treatment)

– Test and start program

Instructions on providing the signals can also be found in the SPC200 or WinPISA manuals, in some cases also in the manual for the field bus module.

4.3 Commissioning with WinPISA

For commissioning with WinPISA you must simulate the existing hardware configuration in WinPISA. Refer here to the WinPISA manual for the necessary steps.

With the existing stepping motor indexer module there are one or several stepping motor interfaces in the project window under the SPC200. A stepping motor axis is assigned to each stepping motor interface.

Fig. 4/1: Stepping motor interface

Configuring the axis

In order to configure a stepping motor axis, select the icon of the axis in the project window. With the command [Edit] [Configure] or with a double click on the axis icon, you can open the relevant dialogue window “Parameter set for the .. axis.”

Caution
Incorrectly set parameters can lead to uncontrolled reactions of the connected axes during operation.

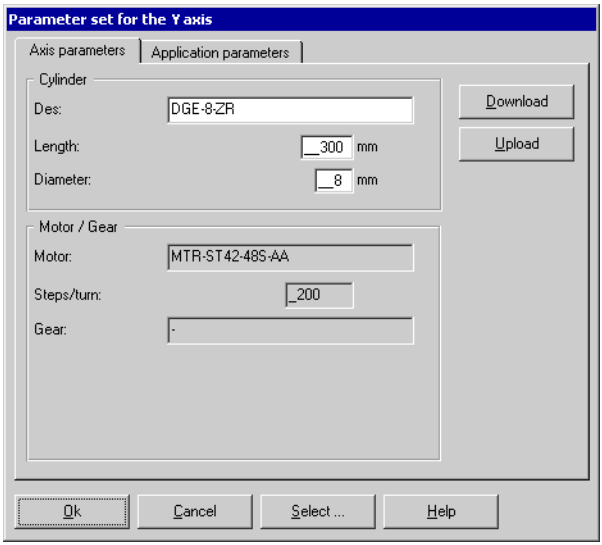

Fig. 4/2: Parameter set for the .. axis, register card "Axis parameters"

4.3.1 Selecting a specification for the axis

A large number of settings and parameters must be defined for an electric axis.
Specifications for drive packages can be selected for this purpose. The specifications are saved in planning files (*.pta). A series of typical specifications can be found in the delivery scope of WinPISA. You can create these specifications yourself with the aid of the Planning Tool (PtTool).

Information on further necessary entries can be found in the following sections.

Please note
The SPC200 with stepping motor indexer module can be used with various stepping motor controllers.
By selecting an appropriate specification for the axis, you determine the following:

– the calculation of the resulting resolution,
– the support of the control output F/H-STEP of the stepping motor indexer module.

Select the specification for the axis as follows:

1. Press the button “Select” in the dialogue window “Parameter set for the .. axis,” in order to select a specification.

2. In the dialogue window “Axis selection” under “Projected axes,” all the electric axes are displayed which exist in the standard directory for planned axes.
   With “Search” you can also display axes from a different directory.

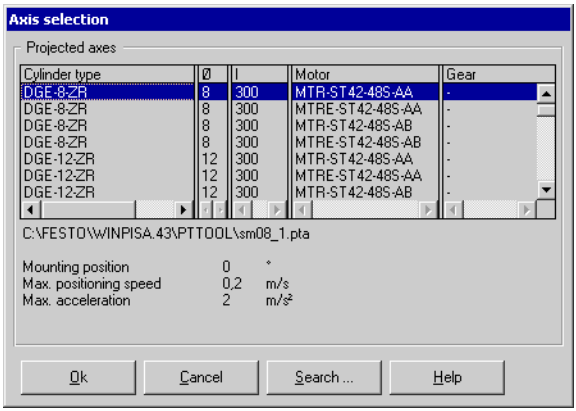

Fig. 4/3: Axis selection (stepping motor controller SEC-ST)

3. Select from the list “Projected axes” the axis which corresponds to the actual axis of your positioning system (see following table). Accept the specification with “Ok.”

Controller	Motor	Effects in WinPISA and in the SPC200
New drive package from Festo with stepping motor controller SEC-ST.	MTR-ST-...	The stepping motor controller supports the step modes 1/1, 1/2, 1/4, 1/5, 1/8 and 1/10 step. The stepping mode is set by means of the DIP switch on the controller. The step mode set on the stepping motor controller must be set in WinPISA. WinPISA calculates from this the resulting resolution which is saved in the SPC200 (see section 4.3.3). [1)] Output F/H-STEP of the stepping motor indexer module is not used.
New drive package from Festo with integrated stepping motor controller MTRE-ST.	MTRE-ST-...	
Old drive package from Festo with stepping motor controller MRC-...	VRDM-... (or MTR-VRDM-...)	The stepping motor controller supports Full/Half step modes. With the setting “Half step,” output F/H STEP of the stepping motor indexer module will be set when the stepping motor controller is actuated.
1) WinPISA supports for the MTRE-ST-... only the step modes 1/1 and 1/2.		

Please note
The new drive packages with stepping motor controller SEC-ST are supported only with WinPISA as from version 4.3 and SPC200 as operating system version 4.6.

Check and, if necessary, correct the settings in the register cards “Axis parameters” and “Application parameters” as described in the following sections.

The specifications for the axes in the delivery scope of WinPISA are usually preset on the step mode 1/2 as well as on a start-stop frequency of 400 Hz.

4.3.2 Configuration of the axis parameters

Check and, if necessary, correct the settings in the register card “Axis parameters” in accordance with your system.

Description of the parameters under “Axis parameters”

The axis parameters are configuration data which describe the composition, the properties and the components of the axis used.

When an axis is inserted from the Planning Tool, the appropriate information on the linear drive is shown in the display fields. After an upload these fields appear empty, as this information is not saved in the SPC200.

Designation	The designation of the linear drive used for the electric axis (display field).
Length	The length of the linear drive used for the electric axis (see type plate). Permitted: 50 ... 10.000 [mm]
Diameter	The size of the linear drive used for the electric axis (see type plate, parameter only for information). Permitted: 8 ... 320 [mm]
Motor	The designation of the stepping motor used for the electric axis (display field).
Steps/turn	The number of steps per turn of the stepping motor used for the electric axis (display field).
Gear	The designation of the gear used for the electric axis (display field).

4.3.3 Configuration of the application parameters

Check and, if necessary, correct the settings in the register card “Application parameters” in accordance with your system.

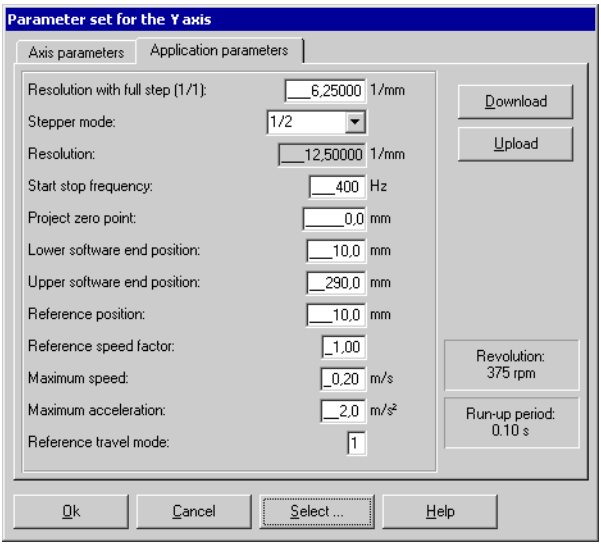

Fig. 4/4: Parameter set for the .. axis, register card “Application parameters”

Description of the parameters under “Application parameters”

The application parameters are configuration data which describe the conditions of use specified by the application.

Resolution with full step

Steps per mm positioning path with step mode “Full step” (1/1):

$$\text{Resolution with full step} = \frac{\text{steps/turn}}{\text{feed constant} * \text{transmission ratio}}$$

Permitted: 0.01000 ... 9999.99999 [1/mm]

Description of the parameters:

Parameters	Description
Steps/turn	Number of steps per revolution of the stepping motor: $\text{steps/turn} = \frac{360°}{\text{step angle}}$ (step angle see type plate)
Feed constant	Feed in mm per turn of the input shaft (linear axis)
Transmission ratio	Transmission ratio i of the gear (see type plate)

Example:
Steps/turn (step angle = 1.8°) = 200 1/turn
Feed constant = 32 mm/turn
Transmission ratio = 1 (no gears)

$$\text{Resolution with full step} = \frac{200\ \text{Steps/turn}}{32\ \text{mm/turn} * 1} = 6.25000\ \text{Steps/mm}$$

Please note
The parameter “Resolution with full step” us only used to determine the final resolution, but **not** saved in the SPC200.

Only the parameters “Resolution” and ”Step mode” are saved.

Stepper mode (MICRO/HALF STEP)

New as from WINPISA 4.3:
Step mode of the stepping motor controller.
The parameter "Stepper mode" replaces the parameter Micro/half step (control panel: MICRO/HALF STEP) of previous WinPISA and operating system versions.

Function and setting possibilities of the parameter depend on the selected axis and on the stepping motor controller (see following table and section 4.3.1).

Selected motor	Stepping motor controller	Step mode	Output F/H STEP	Meaning
MTR-ST-...	SEC-ST	1/1 1/2 1/4 1/5 1/8 1/10	0 0 0 0 0 0	The setting of the step mode must correspond to the DIL switch settings on the controller. The resulting resolution will be calculated as per formula (see "Resolution"). The output F/H STEP on the stepping motor indexer module of the SPC200 is not supported, it remains at "0" irrespective of mode. The control panel always shows "0" (see section 4.4.1).
MTRE-ST-...	Motor with integrated controller	1/1 1/2	0 0	
VRDM-... (or MTR-VRDM-...)	MRC-WS...	Full step Half step	0 1	With half step the output F/H STEP will be set on the stepping motor indexer module of the SPC200. **New as from WinPISA 4.3:** The resulting resolution will be calculated automatically as per formula (see "Resolution"). With the control panel the step mode can be modified (0 or 1, see section 4.4.1).

Please note
The parameter "Stepper mode" will be saved together with the resulting "Resolution" in the SPC200.

The specifications for the axes in the delivery scope of WinPISA are usually preset on the step mode 1/2 as well as on a start-stop frequency of 400 Hz.

Recommendation:
In order to achieve smaller susceptibility for resonance effects, operate 2-phase stepping motors with step mode 1/2. Note that the torque of the motor is thereby reduced.

Resolution

Steps per mm positioning path resulting from the “resolution with full step” (1/1) and the selected step mode.
The following applies:

$$\text{Resolution} = \text{resolution with full step} * \begin{Bmatrix} 1 \\ 2 \\ 4 \\ 5 \\ 8 \\ 10 \end{Bmatrix} \text{with step mode} \begin{Bmatrix} 1/1 \\ 1/2 \\ 1/4 \\ 1/5 \\ 1/8 \\ 1/10 \end{Bmatrix}$$

Accuracy: 0.01000 ..*9999.99999* [1/mm]

Start-stop frequency

Frequency with which the stepping motor can start and stop reliably at the required rotational speed (without loss of step).

Permitted: 80 ... 5000 [Hz]

Caution
By unfavorable choice of the start-stop frequency resonance effects can occur with positioning the axis, which can lead to step losses.

Consider the manufacturer data for the permitted operating conditions of the used motors and drives, e.g. for the permitted start-stop frequency.

With the following parameters 3 to 6 (see Fig. 4/5) you can specify the reference points of your positioning system. The machine zero point is defined by the coordinate of the reference point. All further positions refer to the thus defined machine zero point.

1 Machine zero point

2 Reference and limit switches

3 Reference position

4 Lower software end position

5 Upper software end position

6 Project zero point

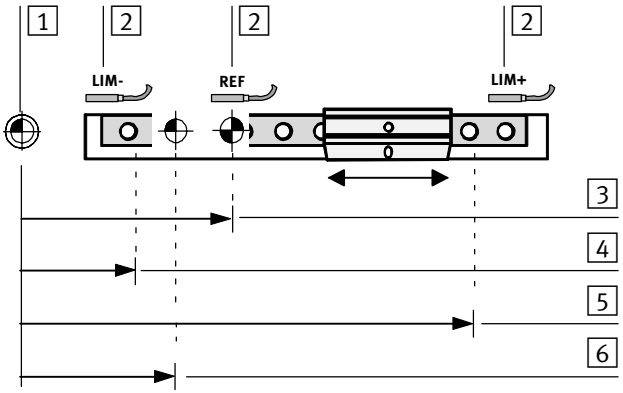

Fig. 4/5: Reference points

Project zero point

Point related to the machine zero point. All positions in position registers and programs refer to the project zero point.

Permitted: 0.0 ... 10.0000 [mm]

Lower software end position

Defined end position on the side of the machine zero point which is monitored by the SPC200 and which must not be overrun. The lower software end position refers to the machine zero point and represents the lower limit of the positioning range.

Permitted: 0.0 ... 10.0000 [mm]

Upper software end position	Defined end position on the side opposite the machine zero point which is monitored by the SPC200 and which must not be overrun. The upper software end position refers to the machine zero point and represents the upper limit of the positioning range. Permitted: 0.0 ... 10.0000 [mm] If both software end positions are set to "0," their function will have no effect.
Reference position	Coordinate of the reference point related to the machine zero point. The machine zero point is defined by this value based on the switching point of the reference switch. Permitted: 0.0 .. 10.0000 [mm] The exact position of the switching point of the reference switch depends on the selected reference travel mode.
Reference speed factor	With this factor the positioning speed V_{Ref} of the reference travel, related to the configured maximum speed, is determined (see Fig. 4/6). Permitted: 0.01 ... 1.00

Caution
By unfavorable choice of the reference speed factor resonance effects can occur with the reference travel of the axis.

Consider the manufacturer data for the permitted operating conditions of the used motors and drives, e.g. for the permitted speeds.

Recommendation:
Do not set the reference speed less than the start-stop frequency.

Please note
When specifying the maximum speed and maximum acceleration, take into account the limits of the linear axis used (maximum permitted speed and feed force).

Maximum speed

Speed for positioning with command G00 or maximum speed for positioning with command G01. The speed factor specified with command G01 refers to the maximum speed defined here.

Permitted: 0.1 ... 10.0 [m/s]

Note that the maximum permitted step frequency (positioning frequency) with the SPC200 is 40 kHz. The maximum step frequency is calculated from the product of the resolution and the maximum speed:
Step frequency = resolution * speed

Maximum acceleration

Maximum acceleration for positioning with the commands G00 and G01. The acceleration factor specified with the command G08 refers to the maximum acceleration defined here.

Permitted: 0.1 ... 100.0 [m/s^2]

Note that due to too small accelerations resonance effects can occur.

Determined number of revolutions and run-up period

From the set application data the maximum number of revolutions as well as the run-up period are determined and indicated:

Value	Description
Revolution	Number of revolutions with the configured maximum speed and resolution: $\text{Revolution} = \frac{\text{Resolution with full step} * \text{Maximum acceleration}}{\text{Steps/turn}}$ Example: $\text{Revolution} = \frac{6.25\frac{1}{mm} * 1000\frac{mm}{m} * 0.2\frac{m}{s} * 60\frac{s}{min}}{200\frac{1}{U}} = 375\frac{\text{turns}}{\text{min}}$
Run-up period	Time, in which the drive with the max. acceleration configured reaches the maximum speed: $\text{Run} - \text{up period} = \frac{\text{Maximum velocity}}{\text{Maximum acceleration}}$ Example: $\text{Run} - \text{up period} = \frac{0.2\frac{m}{s}}{2.0\frac{m}{s^2}} = 0.1s$

Reference travel mode

Mode with which reference travel is to be carried out. This pre-setting applies to reference travel which has been started:
- in the dialogue window “Commissioning the stepping motor” (Command [Online] [Commission] [Stepping motor]),
- or with the control panel.

Permitted: 0 ... 4

With command G74 the reference travel mode in the NC program will be defined individually.

Reference travel modes (see also Fig. 4/6):

Mode	Description
0	Accepting the current axis position as reference point
1	Reference travel in negative direction to reference switch (REF) with acceptance as reference point
2	Reference travel in negative direction to negative limit switch (LIM-) with acceptance as reference point
3	Reference travel in positive direction to reference switch (REF) with acceptance as reference point
4	Reference travel in positive direction to positive limit switch (LIM+) with acceptance as reference point

Note that reference travel with modes 1 and 3 will result in different reference points.

During reference travel the axis moves according to Fig. 4/6. The mechanical arrangement of the reference or limit switches clearly determines the reference point of an axis. In each case, the position accepted as reference point is that at which the slide leaves the switching range of the sensor.

Caution
If an incorrect reference travel mode is set, this can lead to collisions, as all positions of the axis refer to the reference point.

When carrying out reference travel, make sure that the correct mode is used.

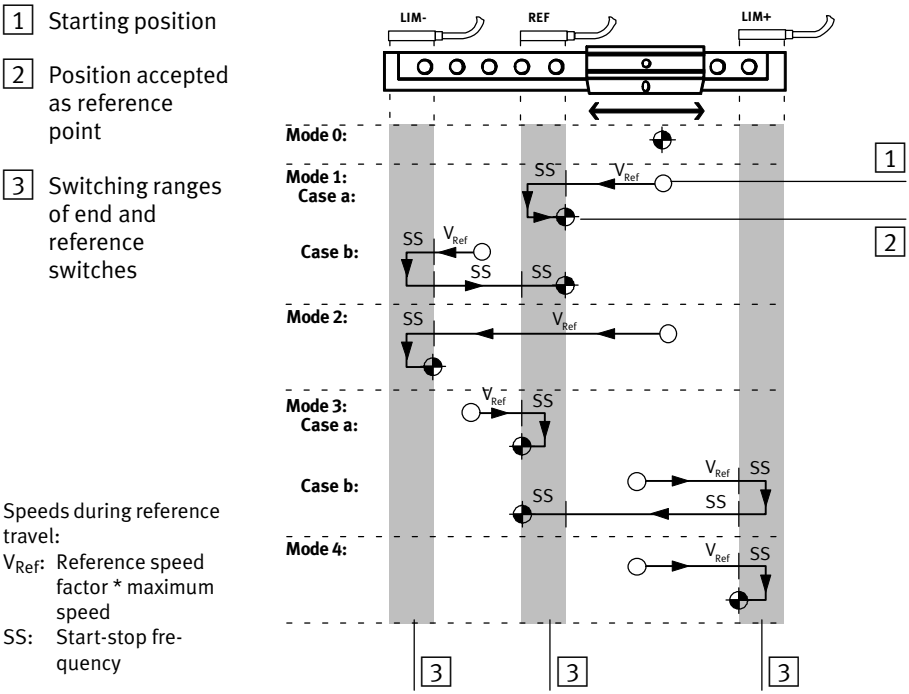

Fig. 4/6: Reference travel modes

After a limit switch fault, the axis loses the reference point. When the fault has been eliminated, new reference travel must be carried out with the axis.

If reference travel is started after a limit switch fault (without Power off/on), the axis will try to leave or find the last actuated switch with the start-stop frequency (SS). If the switch is neither left nor found, the axis will move to the opposite limit switch.

4.3.4 Configuration of the settings for analogue reference value specification

The settings for analogue reference value specification in the register card “Analogue reference value” are identical to the settings for pneumatic axes.

Information on the settings can be found in the WinPISA manual.

4.3.5 Loading the axis configuration into the SPC200

Providing the hardware configuration of the SPC200 corresponds to the project, you can load the configured values into the SPC200 in the dialogue window “Parameter set for the .. axis.”

The online mode must be active for this purpose. If necessary, close the dialogue window “Parameter set for the .. axis” and activate the online mode.

While the online mode is active, load the relevant data in the individual register cards into the SPC200 with the button “Download.”

4.3.6 Functional check of the stepping motor axes

When the axis and application parameters have been set, check that the axes function correctly.

Preparations for the functional check:

- Check to see if the coupling between the motor and the linear axis has been loosened. If this is not the case, loosen the coupling.
- Leave the stepping motor controller switched off. If necessary, switch this off.
- When the axis moves in accordance with the functions in the dialogue window “Commission stepping motor,” it moves in each case at the set reference speed.

If necessary, set a lower reference speed factor during the functional check of the axes.

Proceed with the functional check as follows:

1. Select the command [Stepping motor] in the menu [Online] [Commissioning] in active online mode. The dialogue window “Commission stepping motor” will be displayed.

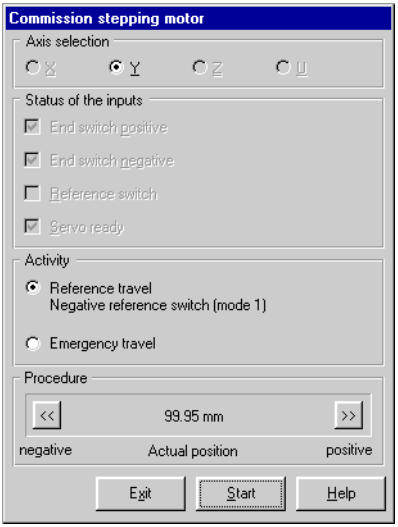

Fig. 4/7: Dialogue window “Commission stepping motor”

Checking the inputs

2. Make sure that the end and reference switches function correctly. In order to do this, you can move the axis by hand when the stepping motor controller is switched off.

   Select the desired stepping motor axis under “Axis selection.” Check the checkboxes of the relevant inputs under “Status of the inputs.”

   Note the different designs of sensors:

   – Limit switches (end switches): N.C., normally closed

   – Reference switch: N.O., normally open

3. Make sure that the axis is always within the positioning range defined by the limit switches when it is switched on and before the start of reference travel.
   Now switch on the stepping motor controller. Under “Status of the inputs,” the checkbox “Servo ready” shows that the stepping motor controller is ready to operate.

Checking the direction of rotation

4. By actuating the arrow buttons under “Procedure,” you can determine the direction in which the motor is to rotate.
   The motor should only rotate when the relevant button is actuated.
   Check the direction of rotation with regard to the resulting direction of movement of the axis. If necessary, switch off the stepping motor controller again and adjust the direction of rotation.

Positioning the axis

5. If the steps up till now have been carried out without any faults, you can now connect the coupling and move the axis with the arrow buttons under “Procedure.” The axis will then move at the configured reference speed.

   Check that the limit switches function correctly. In order to do this, move the axis up to the limit switches: the positive limit switch switches when moving in the positive direction; the negative limit switch switches when moving in the negative direction.

With the function “Emergency travel,” you can move into the positioning range again after a limit switch has been actuated. Select here the option “Emergency travel” under “Activity” and start this with “Start.”
The axis moves in the reverse direction (towards the positioning range providing the limit switch is connected correctly), until the limit switch is left. Travel is interrupted if the limit switch is not left within 2 seconds or if the button “Stop” is actuated.

Reference travel

6. Select the option Reference travel” under “Activity.”
   Check the mode displayed for reference travel.
   Start reference travel with the button “Start.” During reference travel the button “Start” changes to “Stop.”
   With “Stop” you can interrupt the current reference travel.
   The relevant position of the axis, related to the position of the machine zero point, is shown under “Procedure.”

After successful reference travel the functional check of the axis is completed.

4.4 Commissioning with the control panel

If you wish to carry out commissioning with the control panel type SPC200-MMI-1, you should be familiar with the functions of the control panel. Leave the power supply for the stepping motor controller (if necessary, also the compressed air supply) switched off. An overview of the menu system on the control panel can be found in the user manual for the SPC200.

Please note
The control panel type SPC200-MMI-.. does not support all new or extended functions of the SPC200 with firmware as from version 4.6.

The prerequisite for commissioning a stepping motor axis is that the current hardware configuration of the SPC200 is saved (see user manual for the SPC200).

Proceed here as described in the following sections.

4.4.1 Setting project-specific parameters

Cautio
Incorrectly set parameters can lead to uncontrolled reactions of the connected axes during operation.

The SPC200 must know the conditions of use in your project and the type of components used in your positioning system. Undertake the necessary settings in the following menus:

Menu	Description
SPC200 READY AXIS PARAM. >	Axis parameters; Specifications on the axes used
SPC200 READY APPLIC. PARAM.>	Application parameters; Specifications on the conditions of use

When you have selected a menu, use the arrow buttons to set the axis identifiers of the stepping motor axis to be configured and confirm this with the ENTER key:

```
AXIS PARAM.   >>
X:
```

You can then set the parameters described below.

Axis parameters

Menu AXIS PARAM

Set the following parameters (description of the parameters see section “Commissioning with WinPISA”):

Menu AXIS PARAM (axis parameters)	
CYL. LENGTH	Length of drive

Application parameters

Menu APPLIC PARAM

Set the following parameters (description of the parameters see section “Commissioning with WinPISA”):

Menu APPLIC PARAM (application parameters)	
RESOLUTION	Resolution
START/STOP FREQ	Start-stop frequency
POS. BASEPOINT	Project zero point
LOWER END POS.	Lower software end position
UPPER END POS.	Upper software end position
REFER. POSIT.	Reference position
REFER. SPEED	Reference speed factor
MAX. SPEED	Maximum speed
MAX. ACCELER.	Maximum acceleration
MODE OF REFER.	Reference travel mode
MICRO/HALF STEP	Step mode (Micro/Half step) – with SEC-ST-...: always 0 – with MRC-...: 0 or 1 (see following sections)

On the control panel display the parameter MICRO/HALF STEP corresponds to the step mode (see section 4.3.3).

– If stepping motors type MTR-ST with the corresponding power unit type SEC-ST are used or the integrated motor unit MTRE-ST, the value “0” will always be shown. It must not be modified with the control panel.

– If stepping motors type ”VRDM” are used and with the corresponding power unit type ”WS5”, the stepper mode can be modified with the control panel (0 or 1).

With the parameter RESOLUTION the resulting resolution will be displayed and can be modified.

4.4.2 Functional check of the stepping motor axes

When the axis and application parameters have been set, check that the axes function correctly.

1. Preparations for the functional check:

   • Check to see if the coupling between the motor and the linear axis has been loosened. If this is not the case, loosen the coupling.

   • Leave the stepping motor controller switched off. If necessary, switch this off.

   • When the axis moves in accordance with the functions in the dialogue window “Commission stepping motor,” it moves in each case at the set reference speed.
   If necessary, set a lower reference speed factor during the functional check of the axes.

Check the inputs

2. Make sure that the end and reference switches function correctly. In order to do this, you can move the axis by hand when the stepping motor controller is switched off.

   Select the command STEP MOTOR INPUT in the menu DISPLAY and press the Enter key.
   The cursor is positioned on the axis identifier. Select the desired axis with ↑ or ↓ and position the cursor on the entry LIM+ with →.

   ```
   STEP MOTOR INPUT
   Y: LIM+ = 1
   ```

   With ↑ or ↓ switch between the inputs. The state of the individual input is shown with “0” or “1.”

   When checking the sensors, note their different designs:

   – LIM+, LIM-:
     Limit switches (end switches): N.C., normally closed

   – REF:
     Reference switch: N.O., normally open

3. Make sure that the axis is always within the positioning range defined by the limit switches when it is switched on and before the start of reference travel.
   Now switch on the stepping motor controller. The input “Servo ready” (SRDY) shows with a 1-signal that the stepping motor controller is ready to operate.

Checking the direction of rotation

4. Select the command AXIS in the menu TEST/DIAG and press the Enter key. With ↑ or ↓ select the identifier of the stepping motor axis and confirm the selection with the Enter key.
   You are now in the menu TEST/DIAG AXIS.

   Accept the command JOG AXIS with the Enter key. The cursor is positioned on the sign "+" after the coordinate specification.

   ```
   JOG AXIS
   Y:+0000.00 +
   ```

   With ↑ or ↓ you can switch between "+" for positive direction and "-" for negative direction.
   By pressing the Enter key, you can determine the direction in which the motor is to rotate.
   The motor should only rotate when the Enter key is pressed.

   Check the direction of rotation with regard to the resulting direction of movement of the axis. If necessary, switch off the stepping motor controller again and adjust the direction of rotation.

Positioning the axis

5. If the steps up till now have been carried out without any faults, you can now connect the coupling and move the axis in the relevant set direction with the Enter key.

   Check that the limit switches function correctly. In order to do this, move the axis up to the limit switches: the positive limit switch switches when moving in the positive direction; the negative limit switch switches when moving in the negative direction.

   If necessary, check the status of the limit switches on the control panel (command STEPMOTOR INPUT, see Step 2).

With the function “Emergency travel,” you can move into the positioning range again after a limit switch has been actuated. In order to do this, select the command EXIT FROM LIMIT in the menu TEST/DIAG AXIS with → and confirm this with the Enter key.

```
EXIT FROM LIMIT
Y:+0326.88     ?
```

Start emergency travel with the Enter key.
The axis moves in the reverse direction (towards the positioning range providing the limit switch is connected correctly), until the limit switch is left. Travel is interrupted if the limit switch is not left within 2 seconds or if the Esc or Enter key is pressed during reference travel.

Reference travel

6. If necessary, check again the configured mode for reference travel.
   Select the command REFERENCE TRAV in the menu TEST/DIAG AXIS with →.
   Start reference travel with the Enter key.
   The relevant position of the axis, related to the position of the machine zero point, is displayed:

```
REFERENCE TRAV.
Y:+0100.00
```

   The current reference travel can be interrupted with the Esc key or with the Enter key.

After successful reference travel the functional check of the axis is completed.

4.5 Program example

Enter a simple test program in order to check the configuration and the axis set-up.
Program some positioning movements.

Proceed as described in the section “Commissioning ...” in the SPC200 manual or in the WinPISA manual.

The test program for a stepping motor axis can contain e.g. the following records:

NC record	Description
N000 G74 Y1 [1) 2)]	Reference travel in negative direction to reference switch (REF)
N001 G04 100	Dwell time of 1 s
N002 G01 Y100 FY10 [1)]	Move at 10 % of the defined maximum speed to Y = 100 mm
N003 G01 Y500 FY50 [1)]	Move at 50 % of the defined maximum speed to Y = 500 mm
N004 G04 100	Dwell time of 1 s
N005 M30	Program end with repeat

1) Use the axis identifier of the stepping motor axis
2) Reference travel mode appropriate for the axis

Then check the program sequence as described in the SPC200 manual or in the WinPISA manual.

4.6 Instructions on operation

Take the following instructions and recommendations into account when programming positioning systems with electric axes:

Please note
Make sure that all stepping motor axes:
- always lie within the positioning range defined by the limit switches when they are switched on and before the start of reference travel.
- carry out reference travel when the SPC200 or the stepping motor controller is switched on or, if applicable, after faults.

Stepping motor axes are operated in an open control loop. Modifications to the position of the axis when the holding torque is switched off (e.g. stepping motor controller switched off by EMERGENCY STOP), or “lost steps” (e.g. collision, overload) cannot therefore be taken into account.

Please note
Take into account any functions implemented within the framework of the EMERGENCY STOP concept in the NC programs.

Note that not all programming commands of the SPC200 are valid for electric axes, and that individual programming commands for electric and pneumatic axes differ from each other in their function (see SPC200 manual or WinPISA manual).

Follow the maintenance instructions for the components used.

Caution
By positioning the axis with unfavorable positioning speeds resonance effects can occur, which can lead to step losses.

Consider the manufacturer data for the permitted operating conditions of the used motors and drives, e.g. for the permitted start-stop frequency or for the permitted positioning speeds.

Factors of influence for the positioning speeds:

Factors of influence	Observe with
– Start-Stop frequency – Reference speed factor – Maximum speed – Maximum acceleration	Parametrizing (Commissioning)
– Speed factor (FX...) during positioning with G01 – Acceleration factor (G08) during positioning with G01	Operation

Recommendation:
Make sure during operation that the minimum positioning speed is never less than the start-stop frequency set (see manufacturer data of the components used).
Note that due to too small accelerations resonance effects can occur.

The resonant frequency is for drives with 2-phase stepping motors usually between 50 and 250 Hz.

Diagnosis and error treatment

Chapter 5

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5.1 General instructions on diagnosis

Information on general diagnosis and fault treatment can be found in the manual for the SPC200 type P.BE-SPC200-... or in the WinPISA manual.
This chapter contains special information on diagnosing the stepping motor indexer module.

General diagnostic possibilities

The SPC200 offers extensive and user-friendly possibilities of diagnosis and fault treatment. The following possibilities are available:

- The LEDs on the stepping motor module display information on the operating status of the connected stepping motor axis.
- The LEDs on the SPC200 and on the connected field devices show directly configuration faults, hardware faults, string faults, bus faults, etc.
- The control panel shows detailed fault messages coded in the form of an 8-figure hexadecimal number.
- In online mode WinPISA shows the 8-figure fault message as well as a description of the fault in clear text.
- The output bit READY of the SPC200 shows the basic readiness of the system to operate.

5.2 On-the-spot diagnosis

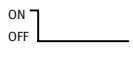
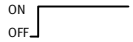
The two LEDs on the stepping motor indexer module enable a speedy on-the-spot diagnosis to be made:

– FAULT LED (red)

– STATUS LED (green)

FAULT LED (red)	STATUS LED (green)	Operating status
is off	is off	Operating voltage not applied
lights up	is off	Function card has not started; SPC200 defective or function card defective; servicing required
lights up	flashes for a long time	Limit switch actuated, short circuit or incorrect polarity at sensor input or internal fault
is off	flashes briefly	Initialization phase Reference travel not carried out or reference travel no longer valid (Servo Ready interrupted)
is off	flashes for a long time	Operating status normal no axis movement/positioning task
is off	lights up	Axis moves

Description of the LED signals

Signal	Description	Signal	Description
	is off		flashes for a long time
	lights up		flashes briefly

5.3 Diagnosis with WinPISA

In online mode WinPISA offers the following possibilities of diagnosing stepping motor axes:

– Status display

– Display of the inputs of the stepping motor indexer module

Further notes and diagnostic possibilities can be found in the WinPISA manual or in the online help.

Status display

In order to display the status, select the command [Status display] in the menu [Online] [Diagnosis].
Select the axis identifier of the desired stepping motor axis in the register card “System.”

Under “Software version” the software version of the stepping motor indexer module is displayed.

Whether or not reference travel has been carried out is shown after the entry “Reference travel.”

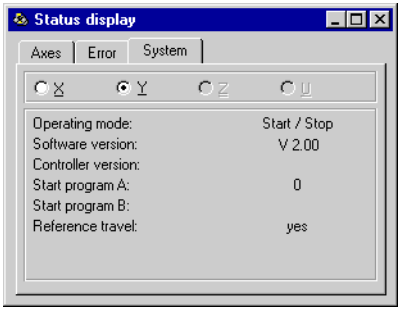


Fig. 5/1: Status display, register card System

The other entries correspond to the display for a selected pneumatic axis (see WinPISA manual).

Display inputs

In order to display the status of the inputs, select the command [Stepping motor module] in the menu [Online] [Observe].

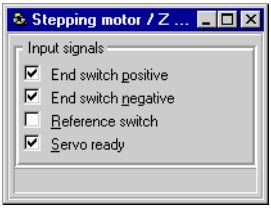


Fig. 5/2: Observe stepping motor module

The inputs are shown by means of checkboxes as follows:

Checkboxes	Input	Description	Remedy
End switch positive (Limit switch positive)	LIM+	When the checkbox is deactivated, the positive limit switch (N.C.) is actuated.	Push the axis into the positioning range (if necessary emergency travel)
End switch negative (Limit switch negative)	LIM-	When the checkbox is deactivated, the negative limit switch (N.C.) is actuated.	Push the axis into the positioning range (if necessary emergency travel)
Reference switch	REF	When the checkbox is activated, the reference switch (N.O.) is actuated.	–
Servo ready	SRDY	When the checkbox is deactivated, the stepping motor controller does not indicate readiness to operate.	Check the stepping motor controller or cabling (bridged in the cable for the SEC-ST)

5.4 Diagnosis on the control panel

The control panel offers the following possibility of diagnosing stepping motor axes:

– Display of the inputs of the stepping motor indexer module.

Further notes and diagnostic possibilities can be found in the SPC200 manual.

Display inputs

1. Select the command STEPMOTOR INPUT in the menu DISPLAY.
2. Then select the axis identifier of the stepping motor axis with ↑ or ↓. Accept this with the Enter key.
3. Position the cursor on LIM+ with →. You can switch from one input to another with ↑ or ↓. The status of the individual input is shown as “1” for 1-signal or “0” for 0-signal.

```
STEPMOTOR INPUT
Y: LIM+ :1
```

Meaning of the inputs (description see section “Diagnosis with WinPISA”):

Input	Meaning
LIM+	0-signal: Positive limit switch actuated
REF	1-signal: Reference switch actuated
LIM-	0-signal: Negative limit switch actuated
SRDY	1-signal: Stepping motor controller sends message Ready to operate

5.5 Emergency travel

If a limit switch is actuated, the axis can be pushed manually into the positioning range again when the stepping motor controller is switched off.
Alternatively, an axis can be moved into the positioning range again with the function “Emergency travel.”

Caution
Movement outside the limit switches may result in a collision.

When the device is switched on, the axis must lie within the limit switches.

The function “Emergency travel” may only be used if a limit switch has been actuated as a result of manual positioning or due to a program fault during the commissioning phase.

Emergency travel procedure

When the function “Emergency travel” is started, the axis moves out of the range of the actuated limit switch in the direction of the positioning range of the axis. The axis moves until the switching range of the limit switch is left, however for max. 2 s (e.g. in the event of cable fracture in the limit switch cable).

Please note
Before starting emergency travel, make sure you understand the function of the limit switches.

Note that the limit switch opposite cannot be recognized during emergency travel.

Carry out emergency travel with WinPISA as follows:

1. Select the command [Stepping motor] in the menu [Online][Commission].

2. Select the axis identifier of the stepping motor axis in the dialogue window “Commission stepping motor.”
   If necessary, check the displayed status of the relevant inputs.

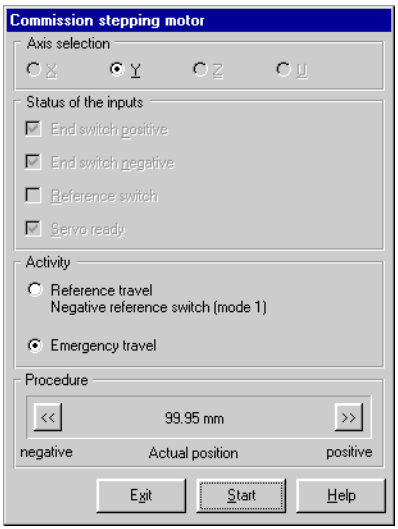


Fig. 5/3: Commissioning the stepping motor

3. In order to carry out reference travel, select the option “Emergency travel” under “Activity.” Start emergency travel with “Start.” The axis moves from the limit switch into the positioning range.
   During emergency travel the button “Start” changes to “Stop.” With “Stop” you can interrupt the current emergency travel.

Carry out emergency travel with the control panel as follows:

1. In order to carry out emergency travel, select the command AXIS in the menu TEST/DIAG.
2. Then select the axis identifier of the stepping motor axis with ↑ or ↓. Accept this with the Enter key.
3. Now select the command EXIT FROM LIMIT with →.
   Start emergency travel with the Enter key.
   The current emergency travel can be interrupted with the Esc key or with the Enter key.

5.6 Notes on judging the positioning behaviour

Resonance effects can lead with stepping motor axes to step losses and/or uncontrolled positioning behaviour. Determined by their principle 2-phase stepping motors are more susceptible to resonance effects than 3- or 5-phase stepping motors.

The following table contains notes on judging the positioning behaviour as well as on the possible remedy.

Effect	Possible cause	Possible remedy
Actual position “moves” with positioning in both directions	Loss of steps by resonance effects	• Increase acceleration • Increase start-stop frequency • Speed FX.. (FY.., FZ.., FU..) on positioning with G01 is set too low, increase • Reduce motor current • Increase maximum speed or reference speed factor • With 2-phase stepping motors: increase resolution, that means operate the motor with step mode 1/2 or 1/4 instead of 1/1 (note that torque will be reduced)
Motor runs ”roughly” and/or produces untypical noises	Drive operates in the range of the resonance	

Technical appendix

Appendix A

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A.1 Technical specifications

Type	SPC200-SMX-1
Temperature range – Operation – Storage/transport	 - 5 ... + 50 °C - 20 ... + 70 °C
Weight	69 g
Relative humidity	95 %, non-condensing
Connection SIGNALS (X31) – External supply (pin 4, pin 5) – Sensor inputs (pin 1 ... 3) – Current consumption (at 24 V) – Reference potential	 24 V DC, ± 15 % [1] Inputs based on IEC 1131-2 type 2 24 V DC, positive-switching (PNP) Typ. 8 mA 0 V
Connection AMPLIFIER (X30) [2] – Input (+/- READY) – Outputs (+/- DIRECT, +/- PULSE, +/- ENABLE, +/- F/H STEP) – Step frequency – Frequency ramp – Positioning range – Resolution	 + 24 V (connected internally with pin 4 of the SIGNALS plug) via relay contact Push-pull control (electric as per RS 485) 80 Hz ... 40 kHz Max. 500 kHz/sec 0.00 ... *9999.99* mm 0.01000 ... *9999.99999* steps/mm
Electromagnetic compatibility – Interference emitted – Resistance to interference	 Tested as per DIN EN 61000-6-4 (industry) [3] Tested as per DIN EN 61000-6-2 (industry)
Vibration and shock – Vibration – Shock	 Tested as per DIN/IEC 68 part 2-6; (0.15 mm path at 10 ... 58 Hz, 2 g acceleration at 58 ... 150 Hz) Tested as per DIN/IEC 68 part 2-27; (± 30 g at 11ms duration; 15 cycles)

1) Note the tolerance of the connected sensors.
2) Pin-compatible with the stepping motor controllers of the Festo drive package for 5 V control signals.
3) The SPC200 is intended for industrial usage.

A.2 Internal circuitry

Circuitry of control connection (AMPLIFIER, X30)

Circuitry of the outputs (+/- DIRECT, +/- PULSE, +/- ENABLE, +/- F/H STEP):

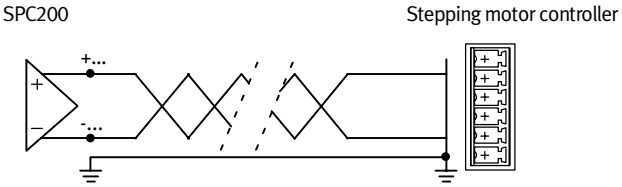

Fig. A/1: Principle RS 485 / RS 422

Circuitry of the inputs (+/- READY):

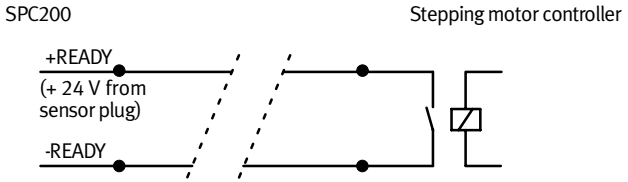

Fig. A/2: Relay contact

On the connecting cable for the SEC-ST the input READY is bridged.

Circuitry of sensor connection (SIGNALS, X31)

Circuitry of the inputs (LIM+, REF, LIM-):

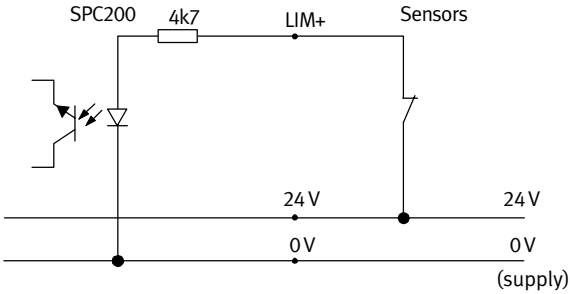

Fig. A/3: Sensor inputs

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